ation of the pest. But we fear that it is too late now to do more than to oppose the insect by special methods of cultivation, and to institute stringent measures to try to prevent the invasion of districts not yet attacked.

The weevil itself is a greyish beetle, very similar in shape to our own destructive apple weevil (*Anthonomus pomorum*, L.), which belongs to the same genus, but it is larger, measuring nearly a quarter of an inch in length. The eggs are laid singly in the "squares" or buds, which afterwards fall, or else in the "bolls" or seed-pods, in one of which latter sometimes as many as twelve of the thick whitish grubs may be found. They do not attack the leaves.

The history of this insect is curiously like that of the Colorado potato beetle. In both cases insects previously only known to entomologists, and feeding in comparatively small numbers upon some wild plant (the original food-plant of the Boll-weevil has not yet been determined), have attacked a cultivated plant, and increased enormously with devastating effects, and spread over a large tract of country. One subject which demands immediate attention from Governments (apart from those of countries already infested) is the instant adoption of any precautionary measures which may be necessary to prevent the danger of the insect being carried from Texas or Mexico to other cotton-growing countries, such as Africa or India.

W. F. KIRBY.

GEOLOGICAL STUDIES IN PERU.

THE third number of the *Boletín del Cuerpo de Ingenieros de Minas del Peru* (Lima, 1903), by Francisco Alayza y Paz-Soldán, director of the survey, raises several matters of general interest to geologists. It deals with the districts of Moquegua and Tacna, including some striking volcanic country between the Andes and the coast. The terrific eruption of Huainaputina in 1600 has left its traces in immense deposits of scoriæ across the adjacent country; the crater of the mountain was completely blown away, and a barrier was formed by the ejected blocks, strong enough to convert the Tambo River for twenty-eight hours into a lake. Part of the devastation was due to the bursting of this barrier, and the phenomena of earthquake and explosion justify the ranking of this catastrophe among the greatest in the human period. Since 1600 the volcano has become completely extinct. Its northern neighbour, Ubinas, on the same line of activity, is, however, looked on with suspicion, and still emits vapours, accompanied by a continuous roaring. These emanations have kaolinised the felspars in the surrounding lavas, and have formed alums, anhydrite, and sulphur near the vent. Though the last eruption, about which little is recorded, took place in 1662, it was of cataclysmic magnitude, and the author points out that repetitions may reasonably be expected.

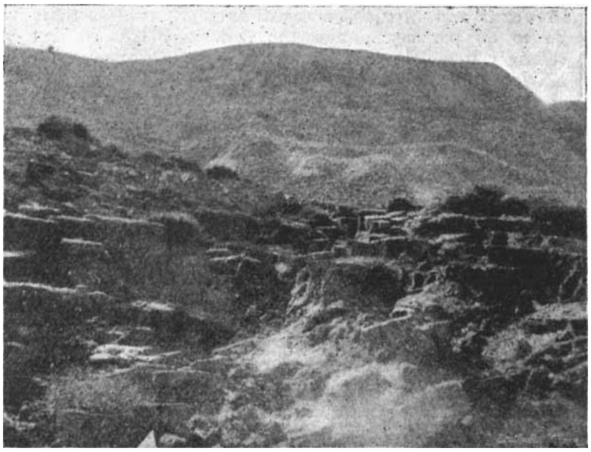

FIG. 1.—Ground disturbed by subsidence, Pallata.

Disturbances of quite another nature are described from Pallata, where sudden fractures of the volcanic surface have occurred as recently as 1902, leading to both depression and elevation. These are traceable to the absorption of water by the underlying tuffs, much as, according to Arcidiacono, the "earthquake" of Nicosia in 1901 was caused by the swelling up of clays during a rainy season, beneath a series of Miocene sandstones. The four excellent illustrations make us desire more from this little known region of Peru. It is unnecessary to emphasise the importance of the volcanic chain in connection with the Pacific coast-line, and with the suggestion, made by Rey y Bassadre, of a companion chain opening along some hidden fissure out at sea.

G. A. J. C.

RELATION BETWEEN TEMPERATURE AND ELEVATION.

IN a communication to the *Comptes rendus* of January last Prof. Teisserenc de Bort gave a condensed account of the research relating to the decrease of temperature with elevation in the region of Paris. This investigation is, perhaps, the most complete that has been undertaken, for the deductions are made from the discussion of an excellent series of 581 aërial soundings by means of *ballon-sonde* extending over five years. From so many observations the general conclusions are therefore of considerable weight, and the results of great importance. The author divides the observations into two groups, one (A) showing the results of 581 ascents, and the other (B) restricted to 141 ascents when the altitude attained fourteen kilometres. In the tabular statements which accompany the paper the temperature values are given for every 500 metres up to a height of 5000 metres, after which values for each kilometre rise are adopted; the results are also grouped to show the changes between the four seasons of the year. Two sets of values for the air temperature in degrees Centigrade are given here, namely, those obtained during summer and winter, the letters under each heading belonging to the groupings previously referred to:—

Altitude	Summer		Winter	
	A	B	A	B
Ground	+13·5	+13·0	+ 1·7	+ 1·9
500 m.	+13·9	+13·6	+ 1·1	+ 1·4
1,000	+11·8	+11·8	− 0·4	− 0·2
1,500	+ 9·2	+ 9·7	− 1·9	− 0·2
2,000	+ 6·8	+ 7·3	− 3·7	− 1·4
2,500	+ 3·3	+ 5·0	− 5·7	− 3·7
3,000	+ 1·7	+ 2·1	− 8·2	− 6·0
3,500	− 0·4	+ 0·2	−10·9	− 8·7
4,000	− 3·4	− 2·7	−13·6	−10·9
4,500	− 5·9	− 5·3	−16·7	−14·2
5,000	− 9·3	− 8·3	−19·8	−17·0
6,000	−15·3	−14·8	−26·4	−23·7
7,000	−22·3	−21·7	−33·6	−31·5
8,000	−29 9	−29·3	−40·8	−39·0
9,000	−37·9	−38·0	−47·4	−46·9
10,000	−45·2	−45·3	−52·9	−54·0
11,000	—	−50·3	—	−57·9
12,000	—	−52·7	—	−57·9
13,000	—	−51·5	—	−56·9
14,000	—	−51·3	—	−55·5

The author refers in some detail to the peculiarities of the rate of decrease of the temperature, and indicates the "zone isotherme" previously noted by him, which lies at an altitude of about 11 kilometres, in which the temperature ceases to decrease, its altitude being the same for every month throughout the year.

THE RELATION OF MATHEMATICS TO ENGINEERING.[1]

WE may sum up what seem to be the best ideals in secondary school mathematics as follows:—

These ideals come from the engineering professions. They insist upon quality rather than quantity. They insist that the problems shall be largely concrete and shall be worked out to an accurate numerical result. They insist

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[1] Abridged from an address delivered by Prof. C. A. Waldo, as president of the section of mechanical science and engineering of the American Association, at the St. Louis meeting.

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that the thought shall precede the form, that the symbol shall not conceal the thing symbolised. They insist that systematic and progressive problems based upon every-day experience and observation shall be, to a much greater extent, the materials of education. They demand that the several elementary mathematical subjects, from arithmetic to the calculus, shall develop side by side in the boy's mind. They demand that the mastery of these subjects shall be more the work of the judgment than of the memory. They demand that from first to last, at least during the secondary period, mathematical ability and the ability to think clearly, investigate closely and conclude correctly shall develop together, and to the extent that four well-spent years will on the average permit. Those who formulate these ideas contend that they lead to the correct mathematical training for all professions and all careers.

The proposition that mathematics is the very bone and sinew of an engineering course needs no discussion. It is everywhere conceded. The extent and nature of the mathematical element in the curriculum, however, are two decided fluents with curves of opposite slope. More mathematics but fewer kinds seems to be the tendency. The opinion appears to be gaining ground that the purely descriptive and highly specialised and professionalised elements in our technical courses should be reduced, while more subjects with a mathematical basis, with long unbroken continuity and bound together with a strong logical element should command the attention of the student to the end of his undergraduate period.

Upon the question as to what mathematical subjects shall the undergraduate courses include in our technical colleges, opinions are decidedly at variance. Upon the four ordinary elementary subjects the sentiment is practically unanimous, but these should be principally taught in the secondary schools. The practical people, however, are inclined to relegate analytic geometry and the calculus to the scrap pile. To such subjects as vectors, theory of functions, theory of groups, they allow no place whatever.

One cannot but feel that this verdict against analytic geometry and the elementary calculus—not to mention higher subjects—is a great pity. Especially does it seem true when we recall that instruction in these two lines forms the principal mathematical element of the second and third years of the ordinary technical course, and that the calculus itself is probably the most powerful and wonderful tool for investigation that the genius of man has ever contrived.

Why do practical men almost unanimously place calculus among the dispensable elements of a technical curriculum? The answer, of course, is very simple; they have never found any use for it, probably because they have never learned how to use it. Yet they dare not pronounce against it altogether. They know that Rankine and Maxwell were master mathematicians, and that through this mastery of the most powerful of tools they were able to do for terrestrial what Newton and Laplace did for celestial mechanics. In college the engineer has not learned to use the modern tool called the higher analysis; it remains to him as foreign currency. Out of college he has not time to learn its use.

The most effective teaching of the higher analysis will be possible only when reforms in mathematical instruction have permeated the principal secondary schools.

The teacher should be saturated with his subject. Not only should he be strong and apt on the formal side, but more important still, its inner meaning should be clear to him and its close relation to the phenomena of the objective and subjective life. Some contend that the only man to whom the mathematics of a technical college can be entrusted is an engineer. Does that make any difference? Rather are not these the essential questions? Does the man know his subject? In his teaching can he assemble from engineering and other records the material that will vitalise his work? Is he in sympathy with engineering essentials and ideals?

Throughout the college course the teaching should be mainly concrete. The problem, say from the physical sciences including engineering, should first be presented concretely. It should then be stated in mathematical symbols. The operations performed upon the symbols should be accompanied by drawings or models, the final result reduced to numerical form, and then interpreted in language. Upon every problem the student must bring to bear the whole range of his acquired powers and be taught to select the shortest method within his ability.

In other words, all typical problems should receive a threefold consideraton:—(*a*) its statement in words, and the statement in words of its solution when effected; (*b*) its graphical statement and solution, involving geometry and mechanical drawing with squared paper; (*c*) its analytic statement and solution, ending with a numerical result.

The purely formal should be presented as a necessity arising from the so-called practical, and in order that a body of knowledge and technical ability may be accumulated which will give the student easy control over the practical in whatever one of its various forms experience shows that it may arise.

The problems chosen should be progressive in character, and their mastery should amount to a complete laboratory course in all that part of the higher analysis in which it is desirable that the engineering student should be well versed.

The course should be lecture and seminarium and individual, more after the manner of the German Technische Hochschule. The text-book should become a book of reference. The instructor should know clearly and be able to state accurately the limitations of his methods, but abstruse discussions of obscure points should be postponed as long as a due regard for logical development will allow. Time is wasted in removing difficulties the existence and importance of which the student has not yet recognised.

These are some of the necessary extensions into college work of the reformation now urged upon the secondary schools, and though every one of them seems familiar enough when taken separately, all together their united application to the mathematical courses in our technical colleges amounts to a departure from our present traditional methods little short of revolutionary.

In recent years mathematical instruction in the United States has greatly improved in its thought content, but it has responded slowly and conservatively to modern methods. We are still more English than German. In the work of training a master of the physical sciences the text-book and the senseless repetition of words and formulas have been replaced by the lecture, the laboratory and the seminarium. Why should not mathematics, so intimately related to them, follow their lead and partake in the benefits of modern methods carried to their legitimate and logical completion?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

HARVARD UNIVERSITY has, we learn from *Science*, received a gift of 50,000*l*. from Mr. David Sears, of Boston, a graduate of the class of 1847.

A COMMEMORATION day will be celebrated at Glasgow University on April 19, when an oration will be given by Sir William Ramsay on Joseph Black, who was lecturer on chemistry from 1756 to 1766 in the old college.

DR. HAROLD JACOBY, adjunct professor of astronomy at Columbia University, New York, has been promoted to a professorship. Prof. Jacoby will continue as acting director of the Columbia University Observatory during the absence of Prof. Rees on account of illness. Dr. C. L. Poor, formerly at the Johns Hopkins University, has also been appointed a professor of astronomy, and will be associated with Prof. Jacoby at Columbia.

THE governing body of the South-western Polytechnic, Chelsea, has unanimously appointed Mr. Sidney Skinner, of Christ's College, Cambridge, to the position of principal in succession to Mr. Herbert Tomlinson, F.R.S., who is retiring. Since 1888 Mr. Skinner has been attached to the teaching staff of the Cavendish Laboratory at Cambridge, and also has acted as lecturer and director of natural science studies at Clare College. Mr. Skinner will take up his duties at the polytechnic about the beginning of May next.

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